WATERCRAFT DRIVE UNIT

Inventors:

Derrick Faucheux
15750 Highway 182
Franklin, Louisiana 70538
United States Citizen

Joel J. Miller
214 Cedar Street
Franklin, Louisiana 70538
United States Citizen

Field of the Invention

This invention relates generally to drive units for watercraft and, more particularly, to an improved drive unit for propelling a watercraft through very shallow water.

Background of Invention

Outboard motors are typically used to propel small shallow water boats. These outboard motors generally are comprised of a portable frame on which is mounted an internal combustion engine for power, a substantially vertically orientated drive shaft and housing extending from the engine, a substantially horizontally orientated propeller shaft in communication with a propeller, and a transmission unit positioned between the drive shaft and the propeller shaft to control transfer of engine power from the drive shaft to the propeller shaft and propeller. Such outboard motors typically require a portion of the drive shaft housing and the propeller to be submerged in the water for proper function of the motor. This causes problems in shallow water operation due to chance from frequent interference and

collisions of the propeller and drive shaft housing with the water bottom or obstructions protruding from the water bottom.

Various arrangements are employed with typical outboard motor arrangements to affect their use in shallow water. These arrangements include providing a jacking means to lift the motor and propeller to reduce the depth of propeller submergence in the water or by providing a "tunnel" or channel in the hull of the boat and positioning the motor within the channel to reduce the depth the propeller must extend into the water to propel the boat.

Other outboard motors employ engines having drive assemblies comprised of a longitudinally extending drive shaft or rotating a propeller. Such motors are typically attached to a frame that is mounted on the transom of the boat in such a manner that it may be freely pivoted both up and down and side by means of a tiller or handle mounted on the frame opposite the extending drive shaft. In this manner, the tiller may be used to move the extending drive shaft and rotating propeller into and out of the water to avoid obstructions and side to side for steering as the boat is propelled. Such systems typically employ propellers that spin in only one direction and thus do not easily provide for reversing the direction of the boat. These types of outboard systems are also physically demanding on the operator in that the operator is constantly lifting the driveshaft and propeller into and out of the water during operation. Further, the operator must often stand in the boat during operation, which may increase the risk of falling from the boat if an obstacle is encountered

Another driving mechanism for shallow water watercraft is that described in U.S. Patent 5,931,710 to Clyde Johnson. This mechanism employs a small boat having an inboard-outdrive system to facilitate travel at low speed in very shallow water. The outdrive

mechanism described by Johnson has a propeller drive shaft mounted within a driveshaft tube housing. This driveshaft and tube housing extend longitudinally through the transom of the boat. The drive shaft is attached to a propeller mounted on the driveshaft tube housing for propulsion of the boat. A fin mounted on the driveshaft tube housing below the propeller serves as a propeller guard. The driveshaft is connected to a bearing and bearing box assembly mounted to the boat transom to allow the driveshaft and housing to pivot upward and downward. A chain is attached to the driveshaft tube housing to support the extending driveshaft in a desired horizontal position. A hydraulic shock absorber, mounted to the extending driveshaft tube housing and to the outside of the boat transom below the chain, provides a self-adjusting downward force on the drive shaft to maintain tension on the chain to keep the driveshaft in a substantially horizontal position. When the extended driveshaft encounters an obstruction, the chain and shock absorber mechanism allows the driveshaft to be displaced vertically and then repositioned to its substantially horizontal operating position when the obstruction is passed. A cable and pulley mechanism mounted on the boat is employed to lift the driveshaft and propeller in and out of the water. A pivot pin is mounted on the driveshaft tube allows the use of a steering actuator to pivot the driveshaft from side to side in its horizontal position for steering. This steering actuator is mounted outside the boat and positioned at or just above the water line. The cable and pulley assembly described by Johnson to raise and lower the driveshaft take up space in the small boats where available space is typically limited. The chain and steering actuator described in Johnson are vulnerable to debris and other obstructions common in shallow water that may damage or inhibit the steering and lifting mechanisms creating an inability to drive or steer the boat.

Summary of the Invention

Applicant provides an improved drive unit for a small boat that eliminates the disadvantages associated with the previous systems. The drive unit consists of transom plate mounted on a boat hull. The transom plate has upper and lower outwardly extending brackets and a hull opening, positioned between the upper and lower brackets, for receiving a first rotatable drive shaft segment turned by an engine and transmission means mounted within the boat.

Essential to Applicants' design is a pivot box that is pivotally mounted on the transom plate by bushings, between the upper and lower brackets, in a manner that allows the pivot box to be turned or pivoted horizontally for steering. A hollow extending pipe, or shaft log, is pivotally mounted on bushings at the pivot box to allow the extending shaft log to pivot vertically. Upper and lower drive shaft bearings support a second drive shaft within the extending shaft log. A double universal joint, centrally positioned within the pivot box, forms the connection between the first and second drive shaft segments. The second drive shaft segment extends from the universal joint within the pivot box through the shaft log. A propeller is mounted to the distal end of the second drive shaft for propulsion. The double universal joint allows both the vertical and the horizontal movement of the second drive shaft segment as it rotates during operation.

The shaft log and propeller are protected from obstructions by a skeg plate that extends downward from the shaft log below the propeller. A cavitation plate mounted on the shaft log above the propeller ends outward in a transverse direction from the shaft log. This

cavitation plate is intended to ride the water above the propeller to maintain water pressure around the propeller and avoid cavitation and propeller slippage.

A single acting, spring-return, hydraulic ram is positioned between the upper portion of the pivot box and to the shaft log. The hydraulic ram is actuated by a fluid pump mechanism controlled from a console within the boat. This spring-return, hydraulic ram serves to raise and lower the shaft log and propeller and absorbs impact from obstructions encountered during operation.

Brief Description of the Drawings

Figure 1 is a perspective view of the rear portion of a boat having the drive unit of Applicants' invention.

Figure 2 is an exploded view of the drive unit of Figure 1.

Figure 3 is a longitudinal cross-sectional view of the drive unit of Figure 1.

Figure 4 is a side view of the drive unit of Figure 1.

Figure 5 is a top view of the drive unit of Figure 1.

Figure 6 is a cross-sectional view of the spring actuated hydraulic ram assembly mounted on the lower shaft log of the drive unit of Figure 1.

Figure 7 is a cross-sectional view of a gas actuated hydraulic ram assembly mounted on the lower shaft log of the drive unit of Figure 1.

Figure 8 is a perspective view of the rear portion of a boat having the drive unit of Applicants' invention.

Detailed Description of the Invention

Figure 1 shows a perspective view of the rear portion of a boat (30) having the drive unit (10) of Applicants invention. The drive unit (10) is attached to the transom (31) of the

boat (30) by means of a transom plate (12). Mounted on the transom plate (12) are an upper bracket plate (14) with flange (18A) and a lower bracket plate (16) with flange (18B). Pivotally mounted to transom plate (12) between the upper bracket plate (14) and the lower bracket plate (16) on bushings (17) is a pivot box (20). A hollow extending pipe called a shaft log (22) is pivotally mounted on the pivot box (20) by a pair of extending shaft mounts (24) and bushings (19) to allow the extending shaft log (22) to pivot vertically up and down. It is thought that greased brass bushings would be used for bushings (17) and (19) pivot connects of the pivot box (20) though other suitable materials may be used.

A steering arm (21) is attached to the pivot box (20). The steering arm (21) is used to rotate the pivot box (20) on the bushing (17) to turning the pivot box (20) to the right or left for steering the boat (30). The steering arm (21) is preferably hydraulically activated by means of a hydraulic pump, lines and steering system (not shown) located in the boat (30). While Applicants' suggest a hydraulic steering system for the drive unit (10) herein described, other systems such a cable systems might be utilized to manipulate the steering arm (21).

As shown in Figure 2, an exploded view of the drive assembly (10), and in Figure 3, a longitudinal cross-sectional view of the drive assembly (10), the pivot box (20) is rectangularly configured and pivotally mounted, on bushings (17), between the bracket plates (14, 16). The boat transom (31) has an opening (15A) that corresponds to an opening (15B) in transom plate (12) that is positioned between the upper and lower brackets (14) and (16). A first rotatable drive shaft segment (26), supported on transom shaft bearing (27), through openings (15A) and (15B) is rotated and controlled by an engine and transmission means (not shown) mounted within the boat (30). This first drive shaft segment (26) enters the pivot box

(20) through pivot box drive shaft opening (15C) and terminates at a double universal joint (28) that is centrally positioned within the pivot box (20).

A second rotatable drive shaft segment (29) in connection with the universal joint (28), through pivot box drive shaft opening (15D), extends from the pivot box (20) and through the shaft log (22) and is held in place by an upper drive bearing (33) and a lower, water-lubricated, bronze/rubber bearing (35) and stainless steel bearing sleeve (35A). The pivot box (20) as shown has an open rear face but a cover plate (not shown) may be attached to the rear of the box (20) to cover the universal joint assembly.

A weedless propeller (38) is mounted to the distal end of the second drive shaft segment (29) for propulsion. The double universal joint (28) allows for both vertical and horizontal movement of the second drive shaft segment (29) as it rotates the propeller (38) during operation of the drive unit. Ideally a "true weedless" propeller is utilized to run through tangled vegetation.

The shaft log (22) and bearings (33) and (35) protect the second drive shaft segment (29) from damage and warping. As shown in Figure 3, the lower bearing (35) holds the drive shaft (29) centered in the shaft log (22) as the drive shaft (29) exits the shaft log (22). The lower bearing (35) also acts as an impact bearing mechanism in the event the drive shaft (29) or the propeller (38) encounters an obstruction. The bearing sleeve (35A), shown in cross-section in position on the shaft log (22) in Figure 5, is mounted within the shaft log (22) for easy removal by means of an adjustable spanner wrench obtainable from most marine supply stores. This facilitates the replacement of the bronze/rubber bearing (35) in the event of excessive wear and tear.

A skeg plate (43) is mounted on the shaft log (22) to extend downward from the shaft log to a point below the propeller (38) to protect the propeller from the impact of obstructions that might be encountered in shallow water. A cavitation plate (37) mounted on the shaft log (22) above the propeller (38) extends outward in a transverse direction from the shaft log. This cavitation plate (37) is intended to ride at the water surface above the propeller in order to maintain water pressure around the propeller (38) and avoid cavitation and propeller slippage during operation of the unit.

As can be seen in the drawings, and more particularly in Figure 6, a cross-section through the spring-return hydraulic ram (25), a single acting, spring-return, hydraulic ram (25) is mounted between the top of the pivot box (20) and the shaft log (22). The hydraulic ram (25) has an input fluid port (61) connected to an input fluid line (61A) and a discharge fluid port (63) connected to a discharge fluid line (63A), all actuated by a fluid pump mechanism controlled from a console within the boat (not shown). This spring-return, hydraulic ram (25) serves to raise and lower the shaft log (22) and propeller (38) and absorbs impact from obstructions that push the shaft log (22) upward during operation of the unit.

The ram (25) has a cylindrical housing (53), a ram piston (54), a piston rod (52) and a return spring (55) positioned inside the ram above the ram piston (54). The housing (53) of the ram (25) is pivotally mounted to a first ram bracket (57A) fixed to the pivot box (20) by means of a first ram connector (57B). The distal end of the piston rod (52) is pivotally mounted to a second ram bracket (57C) fixed to the shaft log (22) by means of a second ram connector (57D) fixed at the end of the piston rod (52).

A hydraulic fluid chamber (58) is located within the housing (53) below the ram piston (54) opposite the spring (55). The ram piston (54) is moved against the spring (55) by pumping hydraulic fluid under pressure into the fluid chamber (58) through inlet port (61) via fluid supply line (61A). This movement of the piston (54) draws the piston rod (52) into the housing and thus raises the shaft log (22) and the propeller (38) from the water. The shaft log (22) and the propeller (38) are lowered into the water by releasing the hydraulic pressure on the piston (54) by evacuating the fluid in the fluid chamber through fluid drain port (63) via fluid drain line (63). When the fluid pressure is released, through outlet port (63) via fluid discharge line (63A), the spring (55) pushes against the piston (54) and thus returns or extends the piston shaft (52) lowering the shaft log (22) and the propeller (38). In addition to returning the piston rod (52) to its extended position, the spring (55) serves to absorb some of the impact from the stumps, logs, vegetation, water bottom and other such obstacles that the shaft log (22) and skeg plate (43) will encounter while the unit (10) is operating in shallow water.

The fluid into the ram (25) is controlled by a hydraulic pump (not shown) located in the boat, the pump being controlled by switches mounted on the boat dashboard or console. It is thought that the hydraulic pump will be electrically operated though other hydraulic pumps could be utilized. When the unit (10) is in its operating or float mode, the fluid is removed from the cylinder (58), so that when the shaft log (22) or skeg plate (43) encounters and obstacle the piston rod (52) and thus the piston (54) will retract almost instantaneously against the spring (55) cylinder lifting the propeller (38) up from the obstacle and then the spring will extend the rod (52) to lower the unit after the obstacle is past.

In operation, as shown in Figure 4 and Figure 5, the shaft log (22) extends outward along the longitudinal axis of the watercraft and is pivoted on the shaft mounts (24) and bushings (19) by removing hydraulic fluid from the ram fluid chamber (58) via fluid lines (63A) and fluid inlet port (63) and thereby allowing the associated drive shaft (29) and propeller (38) to be lowered into the water. Once lowered, the drive unit (10) is in its running or operating position. The engine and transmission are engaged to turn the first drive shaft segment (26) which, by means of the double universal joint (28) that is centrally positioned within the pivot box (20), turns the second rotatable drive shaft segment (29) to deliver power the propeller (38). The boat (30) is turned to the left or right by means of the steering arm (21) attached to the pivot box (20).

Lateral movement of the steering arm (21) moves or pivots the pivot box (20) on the bushings (17) in a horizontal direction, and thus the attendant shaft log (22) and propeller (38), to position the shaft log in a desired position to steer the watercraft. In the event an obstacle is encountered by the skeg plate (43), the shaft log (22) is moved vertically away from the obstacle, which in turn, moves the piston rod (52) and its connected piston (52) against the cylinder spring (55) to absorb the impact of the obstacle. When the obstacle is passed, the spring (55) in the ram (25) as well as the weight of the shaft log (22) and propeller (38) returns the unit (10) to its operating position. The shaft log (22) and propeller (38) may be raised as needed by pumping hydraulic fluid under pressure into fluid chamber (58) of the hydraulic ram (25) via fluid supply line (61A). In this manner the unit may be raised as necessary to trailer the boat or to clear debris from the unit components if necessary.

Figure 7 shows an alternate embodiment (45) of the spring-return hydraulic ram (25) shown in Figure 6. In Figure 7, there is shown single acting gas-return hydraulic ram (45) the having a cylindrical housing (73), a ram piston (74), a piston rod (72) and a return gas chamber (75) filled with a compressible gas such as nitrogen positioned inside the ram above the ram piston (74). The return gas chamber (75), and its contained compressible gas, replaces the spring (55) of the hydraulic ram (25).

The housing (73) of the ram (45) is pivotally mounted to a first ram bracket (57A) fixed to the pivot box (20) by means of a first ram connector (57B). The distal end of the piston rod (72) is pivotally mounted to a second ram bracket (57C) fixed to the shaft log (22) by means of a second ram connector (57D) fixed at the end of the piston rod (52) as shown for the spring-return hydraulic ram (25). The gas-return hydraulic ram (45) has an input fluid port (81) connected to an input fluid line (81A) and a discharge fluid port (83) connected to a discharge fluid line (83A), all actuated by a fluid pump mechanism controlled from a console within the boat (not shown). This gas-return, hydraulic ram (45) also serves to raise and lower the shaft log (22) and propeller (38) and absorbs impact from obstructions that push the shaft log (22) upward during operation of the unit.

As shown in Figure 8, the pivot box (20), the bracket plates (14, 16) and the double universal joint (28) of the drive unit (10) may be covered with a boot or shroud (11) to protect these mechanisms during operation of the unit. The shroud (11) may be comprised of a water resistant fabric or other pliable material.

It is thought that the drive unit of Applicants' invention and many of its attendant advantages will be understood from the foregoing description. One skilled in the art will

appreciate that the present invention can be practiced by other than the described embodiments, which are presented for purposes of illustration and not limitation.